REMARKS

Claims 9, 10, 12-17 and 19-24 are pending in this application. By this Amendment, claims 9 and 16 are amended, and new claims 23 and 24 are added. Support for the amendments to claims 9 and 16 and for new claims 23 and 24 can be found in the specification as originally filed, for example, at page 9, lines 4-6; page 14, line 7 - page 15, line 19; page 20, lines 14-17; page 20, line 25 - page 21, line 3; page 24, lines 12-15; page 27, lines 5-13, and in claims 1-4, 9 and 16 as originally filed.

The courtesies extended to Applicant's representative by Examiner Paik at the interview held December 21, 2004, are appreciated. The reasons presented at the interview as warranting favorable action are incorporated into the remarks below and constitute Applicants' record of the interview.

I. Claims 9, 12-16 and 19-22

The Office Action rejects claims 9, 12-16 and 19-22 under 35 U.S.C. §103(a) over U.S. Patent No. 6,080,970 to Yoshida et al. or U.S. Patent No. 5,904,872 to Arami et al. in view of U.S. Patent No. 5,877,473 to Koontz. Applicant respectfully traverses this rejection.

Claim 9 sets forth a "ceramic heater used in an industrial field of semiconductors, comprising: a disk-shaped sintered ceramic substrate; and a heat-generation pattern disposed on a surface of said disk-shaped sintered ceramic substrate, wherein said disk-shaped sintered ceramic substrate has a diameter of 200 mm or more and said disk-shaped sintered ceramic substrate comprises at least one selected from a group essentially consisting of sintered nitride ceramics and sintered carbide ceramics; and said heat-generation pattern has a bending portion arranged along an outer region of the substrate, which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant; a semiconductor wafer is heated on a surface opposite to the surface of the ceramic substrate forming the heat-generating body; and the bending portion has a width within a range of

0.1 mm to 20 mm." Claim 16 sets forth a similar ceramic heater, which includes "a heat-generation pattern embedded within said disk-shaped ceramic substrate," rather than "a heat-generation pattern disposed on a surface of said disk-shaped ceramic substrate." Claims 12-15 and 19-22 depend, directly or indirectly, from claims 9 and 16, respectively.

The Office Action rejects claims 9 and 16, and their dependent claims 12-15 and 19-22, citing Yoshida and Arami, in the alternative, as allegedly teaching a ceramic heater including a disk-shaped ceramic substrate, which may be aluminum nitride, with a heat-generating pattern, having a combination of spiral and bending patterns, disposed on the surface of the ceramic substrate, and a semiconductor wafer heated on the surface opposite to the surface of the ceramic substrate. Arami is further cited for the teaching that the disk-shaped ceramic substrate has a diameter of eight inches or more, in order to accommodate a wafer with a diameter of eight inches. The Office Action admits that neither Yoshida nor Arami disclose or suggest that an arcuate bending portion of a heat-generating pattern has a curvature radius within a range of 0.1 mm to 20 mm. Applicant respectfully submits that neither Yoshida nor Arami disclose or suggest an arcuate bending portion of a heat-generating pattern arranged along an outer portion of a substrate and having a curvature radius within a range of 0.1 mm to 20 mm, so that the pattern width is constant, as set forth in claims 9 and 16. In addition, neither Yoshida nor Arami disclose or suggest that the bending portion has a width within a range of 0.1 mm to 20 mm, as set forth in claims 9 and 16.

Claims 9 and 16 set forth that the "bending portion arranged along an outer region of the substrate ... describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant" and "the bending portion has a width within a range of 0.1 mm to 20 mm." The pattern of bending formed in the outer peripheral portion of the substrate enables temperature uniformity by preventing temperature drops in the outer peripheral portion of the substrate. *See* Specification, page 7, lines 5-19; page 13, line 22 -

page 14, line 4; Fig. 1. Because the bending portion describes an arc having a constant pattern width, lowering of the resistance value of the bending portion of the pattern is suppressed, and the temperature scattering of the heat-generation pattern is prevented. *See* Specification, page 7, lines 5-19. Thus, the uniformity of the temperature of the heating face is improved, even with nitride or carbide ceramic substrates having diameters of 200 mm or more, as set forth in claims 9 and 16. *See* Specification, page 32, lines 1-14; Table 1. This is demonstrated by Examples 1-16 of the instant specification.

The heat-generation patterns of the ceramic heaters of Examples 1-16 include bending portions arranged along an outer region of the substrate having constant widths within the range of 0.1 to 20 mm and curvature radii within the range of 0.1 to 20 mm, as set forth in claims 9 and 16. *See* Specification, page 39, lines 2-10; Table 1. In these Examples, temperature differences of only 1-5°C between the portion of the pattern just above the bending portion and the remainder of the heating face occur, in contrast to the temperature differences of 8-15°C that occur in Comparative Examples 1-4 and Reference Examples 1-4, which were heated for similar amounts of time. *See* Specification, Table 1.

Comparative Examples 1 and 3 and Reference Examples 1 and 3 of the instant specification are illustrations of conventional ceramic heaters. In conventional systems, bending portions of heat-generation patterns have lower resistance values, due to scattering, and the heat-generation quantity is lowered. That is, bending portions have greater width than the remainder of the pattern in conventional systems, which cause lowering of resistance in the bending portions of the pattern relative to the remainder of the pattern. This causes the temperature of the heating face just above the bending portions to be lower than above other areas of the pattern. *See* Specification, page 3, lines 1-7. If right-angle bends are included in the bending portion of heat generation patterns, temperature drops inevitably occur at the right-angle bends. *See* Specification, page 5, lines 3-6; page 5, line 19 - page 6, line 5; Fig. 5.

In Comparative Example 1 and Reference Example 1, the heat generation pattern is located on the surface of the substrate and the bending portion is not arcuate. *See* Specification, page 29, lines 12-21; Table 1. The resulting temperature difference between the portion of the pattern just above the bending portion and the remainder of the heating face is 10°C for Comparative Example 1 and 8°C for Reference Example 1. *See* Specification, Table 1.

In Comparative Example 3 and Reference Example 3, the heat generation pattern is located within the substrate and the bending portion is not arcuate. *See* Specification, page 29, lines 12-21; Table 1. The resulting temperature difference between the portion of the pattern just above the bending portion and the remainder of the heating face is 12°C for Comparative Example 3 and 9°C for Reference Example 3. *See* Specification, Table 1.

In addition, as can be seen from Table 1, conventional systems using an alumina substrate can have temperature rising times between 9 and 15 minutes. *See* Specification, Table 1. Nitride and/or carbide ceramics used as substrates, which have higher heat conductivities, have lower temperature rising times. *See* Specification, page 15, lines 8-12; Table 1. However, nitride and/or carbide ceramic substrates having large diameters are more liable to have temperature drops in the outer peripheral portion of the substrate.

In ceramic heaters according to claims 9 and 16, heat-generation patterns are formed either on the surface of or embedded within a nitride or carbide ceramic substrate having a high thermal conductivity, and the wafer, heated on a surface opposite to the surface of the substrate, is provided with a pattern. Because the thermal conductivity of the ceramic substrate is high, the temperature rising time is short and the temperature rising rate is fast. However, because of the high thermal conductivity of the wafer, any scattering of temperature present in the heat-generation pattern causes temperature distribution on the wafer surface opposite the patterned substrate surface.

The wafer heating apparatus of Yoshida contains a heat-generation pattern including arc portions wider than the straight portions of the heat-generation pattern. *See* Yoshida, claim 1, which corresponds to Comparative Examples 1-4 and Figure 6 of the instant specification. Comparative Examples 1-4 result in temperature differences of 10-15°C between the portion of the pattern just above the bending portion and the remainder of the heating face. *See* Specification, Table 1. Since Comparative Examples 1-4 correspond to Yoshida, it is clear that Yoshida does not disclose or suggest that an arcuate bending portion of the heat-generating pattern having a curvature radius within a range of 0.1 mm to 20 mm and a constant pattern width within a range of 0.1 mm to 20 mm, as required by claims 9 and 16.

Arami discloses a heater in which the heat-generation body is formed on the rear surface of a silica heating plate. *See* Arami, Abstract. However, silica has a low thermal conductivity, and Arami teaches away from the use of AlN or alumina as a substrate because "the heating plate tends to form particles, so that contamination may occur in a processing vessel or on a semiconductor wafer." *See* Arami, col. 1, lines 33-36.

Thus, neither Yoshida nor Arami, alone or in combination, would have rendered claims 9 and 16, or their dependent claims, obvious. Koontz fails to remedy the shortcomings of Yoshida and Arami.

Koontz discloses vehicle windshields having heating elements. *See* Koontz, col. 2, lines 44-56. In particular, Koontz is directed to a technique for providing a heater on glass. *See* Koontz, Abstract.

The heating patterns disclosed by Koontz are provided on or between glass sheets; these sheets are used for vehicle windshields and must transmit light within the visual range. However, Koontz does not disclose or suggest heaters or heat-generation patterns for materials such as the sintered ceramic substrates set forth in claims 9 and 16. Sintered ceramic materials,

such as the sintered nitride ceramics and sintered carbide ceramics set forth in claims 9 and 16, are used in the semiconductor industry and do not transmit light within the visible range. As discussed during the December 21 personal interview, Koontz does not disclose or suggest ceramic substrates that have heat-generation patterns that are operable at temperatures used for heating semiconductor materials, such as the temperatures set forth in claims 23 and 24. At most, Koontz discloses heating elements for glass windshields. *See* Koontz, Abstract. Koontz does not provide any suggestion to use its teachings with respect to heating glass substrates for vehicle windshields for applications in which a heat-generation pattern is disposed on or embedded within an opaque substrate, such as the sintered ceramic materials of claims 9 and 16. Koontz does not disclose or suggest a semiconductor wafer that is heated on the surface opposite to the surface of a sintered ceramic substrate forming a heat-generating body. In fact, Koontz does not teach or suggest any relation or application of its teachings to ceramic heaters or the semiconductor industry.

Thus, unlike claims 9 and 16, Yoshida, Arami and Koontz, alone or in combination, do not disclose or suggest a ceramic heater including a disk-shaped ceramic substrate with a heat-generation pattern on a surface of the disk-shaped ceramic substrate, in which the disk-shaped ceramic substrate has a diameter of 200 mm or more and is made of nitride ceramics and/or carbide ceramics, and the heat-generation pattern has a bending portion which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant and within a range of 0.1 mm to 20 mm; and a semiconductor wafer is heated on a surface opposite to the surface of the ceramic substrate forming the heat-generating body.

Applicant respectfully submits that claims 9 and 16, and their dependent claims 12-15 and 19-22, are patentable over Yoshida or Arami in view of Koontz. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

II. Rejections of Claims 10 and 17

The Office Action rejects claims 10 and 17 under 35 U.S.C. §103(a) over U.S. Patent No. 6,080,970 to Yoshida et al. or U.S. Patent No. 5,904,872 to Arami et al. in view of U.S. Patent No. 5,877,473 to Koontz, as applied above, and further in view of U.S. Patent No. 6,072,162 to Ito et al. or U.S. Patent No. 6,084,215 to Furuya et al. Applicants respectfully traverse this rejection.

Claims 10 and 17 depend from claims 9 and 16, respectively, and set forth the further limitation that "through-holes for inserting support pins are formed on the ceramic substrate."

For at least the same reasons set forth above with respect to claims 9, 11-16 and 18-22, claims 10 and 17 are patentable over Yoshida or Arami in view of Koontz. That is, no combination of these references teaches or suggests a ceramic heater having a heat-generating pattern that "has a bending portion arranged along an outer region of the substrate which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant." In addition, the Office Action admits that Yoshida or Arami in view of Koontz does not disclose or suggest a ceramic heater having through-holes for inserting supporting pins. Neither Ito nor Furuya remedies the shortcomings of Yoshida, Arami and Koontz.

Ito and Furuya are cited for allegedly disclosing a wafer supporting heater having a plurality of through-holes for inserting supporting pins to support a wafer. However, regardless of their actual teachings, neither reference discloses or suggests a ceramic heater having a heat-generating pattern which "has a bending portion arranged along an outer region of the substrate which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant."

Thus, Applicant respectfully submits that claims 10 and 17 are patentable over Yoshida or Arami in view of Koontz and further in view of Ito or Furuya. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

III. New Claims 23 and 24

New independent claims 23 and 24 are added by this amendment. New claim 23 sets forth, in pertinent part, a "ceramic heater used within a temperature range of from 150°C to 800°C in an industrial field of semiconductors, comprising: a disk-shaped sintered ceramic substrate; and a heat-generation pattern disposed on a surface of said disk-shaped sintered ceramic substrate, wherein said disk-shaped sintered ceramic substrate has a diameter of 200 mm or more and said disk-shaped sintered ceramic substrate is made of at least one selected from a group essentially consisting of sintered nitride ceramics and sintered carbide ceramics; and said heat-generation pattern has a bending portion arranged along an outer region of the substrate which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant; and a semiconductor wafer is heated on a surface opposite to the surface of the ceramic substrate forming the heat-generating body." Claim 24 sets forth similar ceramic heater, which includes "a heat-generation pattern embedded within said disk-shaped ceramic substrate," rather than "a heat-generation pattern disposed on a surface of said disk-shaped ceramic substrate."

Like claims 9 and 16, set forth above, claims 23 and 24 include a ceramic heater having a heat-generating pattern that "has a bending portion arranged along an outer region of the substrate which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant." Applicant respectfully submits that, for at least the same reasons set forth above with respect to claims 9, 10, 12-17 and 19-22, claims 23 and 24 are patentable over the cited references. That is, no combination of these references teaches or suggests a ceramic heater having a heat-generating pattern that "has a bending

portion arranged along an outer region of the substrate which describes an arc having a curvature radius within a range of 0.1 mm to 20 mm, so that a pattern width is constant."

In addition, claims 23 and 24 are directed to heaters used in the semiconductor industry, in particular, ceramic heaters used "within a temperature range of from 150°C to 800°C." As discussed during the December 21 personal interview, Koontz does not disclose or suggest ceramic substrates that have heat-generation patterns that are operable at temperatures used for heating semiconductor materials, such as temperatures within the range set forth in claims 23 and 24.

Thus, Applicant respectfully submits that claims 23 and 24 are patentable over the art of record and are in condition for allowance.

IV. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 9, 10, 12-17 and 19-24 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

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